

wind is only estimated. Of the above cautionary off-shore signals, forty-eight were changed from cautionary. Nine signals were ordered late. In sixty-seven cases, winds of twenty-five miles or more, per hour, were reported for which no signals were ordered.

TEMPERATURE OF WATER.

The temperature of water as observed in rivers and harbors during April, 1884, with the average depth at which the observations were made and the mean temperature of the air at the various stations, are given in the table below. Observations were interrupted by ice at the following stations: Alpena, Michigan, on the 1st; Buffalo, New York, 1st, 6th, 12th, 13th; Detroit, Michigan, 1st, 2d; Duluth, Minnesota, from 1st to 30th; Escanaba, Michigan, 1st to 16th; Mackinaw City, Michigan, from 1st to 18th; Marquette, Michigan, from 1st to 27th; Milwaukee, Wisconsin, 1st 2d, 3d. The highest water temperatures observed during the month were 83° 5 and 79° at Key West and Cedar Keys, Florida, respectively, on the 19th; the lowest were 30° 5 at Alpena, Michigan, on the 7th; 33° 1 at Escanaba, Michigan, on the 17th; and 33° 1 at Buffalo, New York, on the 14th and 30th. The largest monthly ranges were: 21° 1, Cedar Keys, Florida; 17° 7, Chincoteague, Virginia; and 17.5, Alpena, Michigan. The smallest monthly ranges were: 4° 9, Fort Canby, Washington Territory; 4° 6, Wilmington, North Carolina; 4° 3, Eastport, Maine; and 3° 2, San Francisco, California.

Temperature of water for April, 1884.

Station.	Temperature at bottom.		Range.	Average depth, feet and inches.	Mean temperature of the air at station.
	Max.	Min.			
Atlantic City, New Jersey.....	50.1	42.9	7.2	4 7	47.0
Alpena, Michigan*.....	48.0	30.5	17.5	11 6	37.3
Annapolis, Maryland.....	70.0	59.7	10.3	12 6	62.1
Baltimore, Maryland.....	56.6	44.9	11.7	9 8	52.3
Block Island, Rhode Island.....	46.1	37.0	9.1	8 4	42.9
Boston, Massachusetts.....	46.1	34.8	11.3	22 8	42.7
Buffalo, New York *.....	37.9	33.1	4.8	9 7	39.7
Canby, Fort, Washington.....	51.9	47.0	4.9	16 4	50.5
Cedar Keys, Florida.....	79.0	57.9	21.1	11 5	69.0
Charleston, South Carolina.....	68.2	62.0	6.2	41 10	63.3
Chicago, Illinois.....	48.0	38.5	9.5	8 4	44.3
Chincoteague, Virginia.....	60.0	42.3	17.7	4 9	48.8
Cleveland, Ohio.....	48.3	37.8	10.5	14 0	43.5
Detroit, Michigan*.....	48.2	37.0	11.2	22 11	45.5
Delaware Breakwater, Delaware.....	50.3	36.9	13.4	8 9	47.2
Duluth, Minnesota.....	37.7	33.4	4.3	16 3	39.9
Eastport, Maine.....	41.4	33.1	8.3	15 0	36.3
Escanaba, Michigan*.....	73.3	62.0	11.3	12 3	67.2
Galveston, Texas.....	55.6	42.9	12.7	19 0	43.7
Grand Haven, Michigan.....	74.5	61.0	13.5	9 2	67.5
Indianapolis, Texas.....	74.5	67.0	7.5	18 0	68.7
Jacksonville, Florida.....	83.5	74.8	8.7	17 6	76.2
Key West, Florida.....	38.1	33.4	4.7	10 0	37.3
Mackinaw City, Michigan*.....	67.0	55.5	11.5	6 2	57.2
Marquette, Michigan*.....	35.3	35.0	1.3	9 11	35.6
Milwaukee, Wisconsin *.....	45.7	38.7	7.0	8 0	40.9
Mobile, Alabama.....	69.5	56.0	13.5	16 3	66.2
New Haven, Connecticut.....	49.3	35.9	13.4	15 8	44.9
New London, Connecticut.....	44.7	37.5	7.2	12 9	45.4
New York City.....	50.0	37.5	12.5	16 5	47.0
Norfolk, Virginia.....	60.2	50.0	10.2	17 1	54.5
Pensacola, Florida.....	71.5	64.1	7.4	17 5	66.3
Portland, Maine.....	43.0	34.4	9.2	16 9	45.7
Portland, Oregon.....	55.2	49.2	6.0	58 4	54.1
Sandusky, Ohio.....	52.0	39.0	13.0	11 2	44.9
Sandy Hook, New Jersey.....	47.0	39.8	7.2	1 5	47.2
San Francisco, California.....	58.2	55.0	3.2	38 10	55.0
Savannah, Georgia.....	66.7	60.3	6.4	10 7	65.3
Smithville, North Carolina.....	68.0	59.4	8.6	10 0	59.4
Toledo, Ohio.....	55.2	41.6	13.6	12 2	45.7
Wilmington, North Carolina.....	63.6	59.0	4.6	19 8	60.5

* Observations interrupted by ice: see text.

ATMOSPHERIC ELECTRICITY.

AUORAS.

An auroral display occurred during the night of the 24-25th, which was reported from the Missouri valley eastward to Nova Scotia, the most southern point at which it was observed, being in southern Indiana. The following reports relate to this display:

Portland, Maine: a brilliant aurora was observed at 1.50

a. m. of the 25th, consisting of numerous streamers reaching the zenith; the display was obscured by clouds at 2.30 a. m.

Eastport, Maine: aurora from 7.25 p. m., until 3. a. m. of the 25th.

Point Judith, Rhode Island: at 8.30 p. m. of the 24th, an auroral display was observed through the clouds, its influence being felt on the telegraph lines one hour before the display was observed.

Toledo, Ohio: an aurora of moderate brightness was observed from 10 to 10.30 p. m. of the 24th.

Wauseon, Ohio: a moderately brilliant aurora was observed at 9 p. m. on the 24th in the form of short streamers extending upward from a partial arch in the northern sky.

Sunman, Indiana: an aurora was visible at 10 p. m. of the 24th.

Port Huron, Michigan: a diffuse auroral light, with occasional streamers, was observed in the northern sky at 10.50 p. m. of the 24th.

Grand Haven, Michigan: a faint aurora was observed from 9.10 to 11.45 p. m. of the 24th.

Milwaukee, Wisconsin: a brilliant auroral display was observed from 9 to 10.15 p. m. of the 24th, consisting of slender luminous beams having a constant motion.

Sussex, Wisconsin: a beautiful auroral display occurred on the 24th. It first appeared as a dark cloud 10° above the horizon, with streamers and "dancers" extending upward to the zenith. The influence of the aurora on the magnetic needle was very noticeable. Surveyors report that on the morning of the 24th the declination of the needle change 45' to the west, and on the afternoon of that date the instrument became useless. The effects of the aurora upon the needle did not disappear until 3 p. m. of the 25th.

Beloit, Wisconsin: a brilliant auroral display was observed from 8.30 to 10 p. m. of the 24th. It first appeared in the north as a white light, which gradually developed into an arch with several broad bands extending towards the zenith. Later the arch moved upward and the broad bands were succeeded by narrow beams of a pinkish color.

Alpena, Michigan: an aurora was observed at 8 p. m., of the 24th, consisting of a diffuse light, resting upon a dark base of dense haze, in the northwestern sky; at 8.30 p. m. the whole sky except that along the southern horizon was covered with the haze; at 8.40 p. m. very brilliant streamers appeared in the southern sky, reaching an altitude of 25°, and having an apparent motion from east to west; at 11 p. m. the aurora gradually faded away, leaving only a diffused light on the northern horizon.

Fort Totten, Dakota: an auroral beam was observed at 7.45 p. m. in the southern sky, and passing about 5° south of the zenith, terminating in the northwest. This beam was from 2° to 3° in width near the horizon, but at an altitude of 30° it widened abruptly to 9°; at 10.30 p. m. shooting beams were observed in the south. The display ended at 11 p. m.

Dubuque, Iowa: a brilliant aurora was visible from 9.30 to 9.55 p. m., consisting of slender beams extending from a luminous base to a height of 30°.

Davenport, Iowa: a bright aurora was observed in the northwest from 8.30 to 10 p. m., the light extending to an altitude of 45°.

Huron, Dakota: brilliant auroral beams were visible from 8.30 p. m., of the 24th, until after midnight.

Fort Bennett, Dakota: a faint aurora was seen from 9.20 to 9.30 p. m., appearing as slender columns of pale straw-colored light.

Yankton, Dakota: a faint aurora, in the form of an arch, with parallel beams reaching nearly to the zenith, was observed from 9.10 to 9.45 p. m.

Other auroral displays were observed during the month, as follows:

5th.—Manitowoc, Wisconsin.

11th.—Woodstock, Vermont; Westerville, Ohio.

14th.—Cornish and Orono, Maine; Wellsborough, Pennsyl-

vania; Providence, Rhode Island; Halifax, Nova Scotia; Charlottetown, Prince Edward Island.

15th.—Sidney, Nova Scotia.

16th.—Fort Myer, Virginia.

17th.—Westerville, Ohio; Grand Haven, Fort Brady, Manistique, Marquette and Swartz Creek, Michigan; Bismarck and Forts Buford and Totten, Dakota; Milwaukee, Wisconsin; Riley, Illinois.

18th.—Mount Washington, New Hampshire; Fort Brady, Michigan; Fort Totten, Dakota.

19th.—Saint Vincent, Minnesota; Fort Totten and Webster, Dakota.

20th.—Westerville, Ohio; Manchester, Iowa.

21st.—Fort Wayne, Indiana.

22d.—Beloit, Wisconsin.

23d.—Wabash, Indiana.

25th.—Westerville, Ohio.

26th.—Cornish, Gardiner and Orono, Maine; Newport, Vermont; Cambridge, Massachusetts; Westerville, Ohio.

27th.—Orono, Maine.

28th.—New Haven, Connecticut.

THUNDER-STORMS.

Thunder storms were reported in the various districts, as follows:

New England.—2d, 15th to 17th.

Middle Atlantic states.—1st, 2d, 8th, 14th to 17th, 25th to 27th.

South Atlantic states.—1st, 2d, 8th, 13th to 16th, 19th, 21st, 24th to 28th.

Florida peninsula.—5th, 6th, 12th, 14th to 17th, 20th to 23d.

Eastern Gulf states.—1st, 5th, 7th, 8th, 11th to 15th, 17th to 21st.

Western Gulf states.—1st, 3d, 4th, 5th, 10th, 11th, 13th, 14th, 17th to 20th, 26th to 30th.

Rio Grande valley.—11th, 20th, 27th to 30th.

Tennessee.—1st, 2d, 7th, 13th to 15th, 17th, 18th, 19th, 27th to 30th.

Ohio valley.—1st, 2d, 3d, 14th, 15th, 27th to 29th.

Lower lake region.—1st, 2d, 14th to 16th, 27th, 28th, 30th.

Upper lake region.—1st, 7th, 14th, 15th, 18th, 22d, 26th, 27th, 29th, 30th.

Extreme northwest.—Saint Vincent, Minnesota, 29th.

Upper Mississippi valley.—1st, 5th, 12th, 13th, 14th, 17th, 18th, 19th, 26th to 30th.

Missouri valley.—1st, 5th, 12th, 13th, 14th, 17th to 22d, 25th, 26th, 28th to 30th.

Northern slope.—13th, 17th, 26th, 28th.

Middle slope.—2d, 3d, 5th, 6th, 11th to 14th, 17th to 20th, 25th to 30th.

Southern slope.—4th, 13th, 18th, 27th to 30th.

Southern plateau.—4th, 10th, 11th, 16th, 27th, 29th.

Middle plateau.—Utah: Salt Lake City, 11th, 16th; Nephi, 11th, 30th;

Northern plateau.—10th, 21st, 22d, 25th, 29th.

North Pacific coast region.—4th, 5th, 9th, 10th, 21st, 27th.

California.—Los Angeles: 3d; Sacramento and Hydesville, 9th, Princeton, 8th, 9th, 28th; San Francisco, 24th; San Diego, 27th; Benicia Barracks, 28th.

During a thunder storm on the afternoon of the 16th, at Portland, Maine, a violent electrical explosion occurred. Numerous windows were broken by the concussion, and several persons were stunned. Considerable damage was done to the telephone exchange and telegraph office in this city.

OPTICAL PHENOMENA.

SOLAR HALOS.

Solar halos have been observed in the various districts on the following dates:

New England.—2d to 5th, 9th, 12th, 14th, 15th.

Middle Atlantic states.—1st, 5th, 6th, 7th, 12th, 18th, 20th, 25th, 28th.

South Atlantic states.—1st to 4th, 14th, 16th, 18th, 21st, 23th.

Florida peninsula.—Archer, 15th.

Eastern Gulf states.—Pensacola, Florida, 1st.

Western Gulf states.—Fort Smith, Arkansas, 5th; Lead Hill, Arkansas, 1st, 3d, 4th, 6th, 13th, 17th, 25th, 30th.

Tennessee.—1st, 5th, 7th, 11th, 17th, 20th, 30th.

Ohio valley.—1st, 3d to 6th, 8th, 11th, 19th, 28th, 29th, 30th.

Lower lake region.—North Volney, New York, 13th; Toledo, Ohio, 18th, 30th.

Upper lake region.—2d, 6th, 12th, 13th, 17th, 18th, 21st, 22d, 25th, 26th, 29th, 30th.

Extreme northwest.—Fort Buford, Dakota, 10th, 16th.

Upper Mississippi valley.—5th, 11th, 15th, 17th, 21st, 22d, 26th, 27th, 29th, 30th.

Missouri valley.—Vermilion, Dakota, 16th, 20th.

Northern slope.—Genoa, Nebraska, 4th, 5th, 16th.

Middle slope.—Independence, Kansas, 24th.

Southern plateau.—El Paso, Texas, 26th, 27th; San Carlos, Arizona, 26th.

Middle plateau.—1st, 2d, 4th, 5th, 6th, 8th, 11th, 12th, 20th, 22d.

Northern plateau.—Boise City, Idaho, 19th, 26th; Dayton, Washington Territory, 12th.

North Pacific coast region.—Oregon: Roseburg, 6th, 7th, 17th; Albany, 7th, 19th; East Portland, 19th.

Middle Pacific coast region.—1st to 9th, 15th, 20th, 21st, 22d, 24th, 27th.

LUNAR HALOS.

New England.—5th, 8th, 10th, 11th, 15th.

Middle Atlantic states.—1st, 3d, 5th, 7th, 13th, 28th.

South Atlantic states.—1st, 3d to 6th, 30th.

Florida peninsula.—1st, 2d, 3d.

Eastern Gulf states.—1st to 4th, 10th.

Western Gulf states.—1st, 3d, 4th, 9th, 29th.

Tennessee.—3d, 6th, 7th, 9th, 30th.

Ohio valley.—6th, 10th, 17th, 28th, 29th, 30th.

Lower lake region.—1st, 2d, 3d, 5th, 8th, 30th.

Upper lake region.—2d, 4th to 7th, 11th, 12th, 14th, 28th, 30th.

Extreme northwest.—Fort Totten, Dakota, 5th; Fort Buford, Dakota, 10th.

Upper Mississippi valley.—3d, 6th, 27th to 30th.

Missouri valley.—Fort Bennett, Dakota, 8th.

Northern slope.—Fort Shaw, Montana, 1st; Fort Custer, Montana, 6th; Fort Meade, Dakota, 26th.

Middle slope.—3d, 7th, 8th, 9th.

Southern slope.—Fort Elliott, Texas, 4th; Fort Stockton, Texas, 6th.

Southern plateau.—1st, 3d, 6th, 8th.

Middle plateau.—Nephi, Utah, 1st, 8th; Carson City, Nevada, 1st, 6th; Salt Lake City, Utah, 1st, 9th, 30th; Fort Lewis, Colorado, 7th, 8th.

Northern plateau.—Dayton, Washington Territory, 4th; Spokane Falls, Washington Territory, 5th.

North Pacific coast region.—2d, 3d, 5th, 7th.

Middle Pacific coast region.—4th, 5th, 6th, 8th.

South Pacific coast region.—1st, 4th, 5th.

MIRAGE.

Galveston, Texas.—During the afternoon of the 22d, the mainland seemed much nearer than usual, and all elevated and distant objects were seen with great distinctness. A similar phenomenon was also observed on the 23d.

Milwaukee, Wisconsin.—From 2 p. m., of the 24th, until after sunset, Whitefish bay, six miles distant and ordinarily hidden from view, was plainly seen.

Mirages were also observed at the following places:

Webster, Dakota, 16th, 19th, 20th, 21st, 22d, 23d, 24th.

Pretty Prairie, Kansas, 18th, 10th.

Manistique, Michigan, 22d, 23d.

Duluth, Minnesota, 28th.

Red Willow, Nebraska, 17th.

Indianola, Texas, 22d, 24th.